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Temperature trends in different regions of India

A.V. M. S. RAO, P. SANTHI BHUSAN CHOWDARY, N. MANIKANDAN, G. G. S. N. RAO, V. U. M. RAO and Y. S. RAMAKRISHNA

Central Research Institute for Dryland Agriculture, Santoshnagar, Hyderabad-500 059

ABSTRACT

Time series analysis of annual mean, maximum and minimum temperature revealed of 47 stations spread acress different regions in India revealed the increasing trend in maximum temperature, lowest in 20 per cent stations in north zone and highest in 75 percent of the stations in south zone. On the other hand, increase in minimum temperature is observed in above 60 per cent of stations over all zones of India. Same trend is noticed in average temperature trend except in north zone where 45 per cent of stations have shown increasing trend.

Key words: Climate change, temperature change, global climate models, green house gases

The most significant climatic change in recent times is the increase in the atmospheric temperatures due to increased levels of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), ozone (O_3), nitrous oxide (N_2O) and chlorofluoro carbons (CFCs). Global Climate Models projected an increase in mean temperature between 1.4 and 5.8°C by 2100 depending upon different greenhouse gas emission scenarios (IPCC, 2007). This unprecedented increase is expected to have severe impacts on the global hydrological system, ecosystems, sea level, crop production and related processes. The impact would be particularly severe in the tropical areas, which mainly consist of developing countries, including India. In India, the analysis of seasonal and annual surface air temperatures has shown a significant warming trend of 0.57°C per hundred years (Pant and Rupakumar, 1997). Hingane *et al.*, (1985) reported that the countrywide annual surface air temperature has increased by 0.4°C per 100 years in this century but the rate slowed down in the recent three decades. Many scientists have also studied the impact of abnormal increase in air temperature on growth, development and yield of various field crops. According to Samra *et al.*, (2006) onion production in rabi 2007 was affected due to abnormal increase in maximum temperature during the months of March, April and May. Recent reports released by the United Nations Inter-governmental Panel on Climate Change have reckoned that India could witness a 10 to 40 per cent loss in crop production due to the rise in atmospheric temperature by 2080-2100. Simulation studies indicated that wheat production could drop by 4 to 5 million tonnes with every increase of 1 degree celsius in temperature throughout the growing season of this crop. The output of other crops, too, would be adversely hit by changes in the climate. Increasing temperatures in Himachal Pradesh has resulted in decrease in apple production and shifting of apple belts to further higher elevations. In the light of above, the present study was carried out to find region-wise temperature trends over India and research conducted by various scientists on effect of temperature on various crops also discussed.

MATERIALS AND METHODS

Annual mean maximum, minimum and average temperature data of 47 stations spread across the India was collected from IMD and cooperating centers of All India Coordinated Research Project on Agrometeorology, CRIDA, Hyderabad and checked for quality. Five regions viz., northern, western, eastern, southern and central have been created and these 47 stations were put under respective zones as per IMD guidance. (Northern region – 5 stations; Eastern region – 7 stations; Western region – 14 stations; South region – 12 stations and Central region – 9 stations) (Table1). Time series analysis and statistical significance of trends in temperature data was carried out using standard Mann-Kendall test statistics (Libiseller and Grimall, 2002).

RESULTS AND DISCUSSION

Maximum temperature trends

Increasing trend was noticed in 9 out of 12 stations in south region followed by central (67%), east (60%) and west region (57%) (Fig.1a). In north India only 20 per cent of stations were showing increasing as well as declining trend (Table 2). No significant trend was observed in 60 per cent of stations in north region followed by west region (43%), central region (37%), south region (17%) and east region (14%).

Minimum temperature trends

Minimum temperature showed increasing trend in 88 per cent of stations in central and east region followed by north region (80%), south region (75%) and least in west region (57%). The study of Deka and Nath (2008) found that

Table 1: List of stations taken for study

Name of the region	No of stations	Station names
North	5	Bareilly, Bahraich, Jhansi, New Delhi, Varanasi
East	7	Balasore, Daltgunj, Guwahati, Hazaribagh, Kolkata, Krishna nagar, Midnapur
West	14	Ahmedabad, Barmer, Baroda, Deesa, Jaipur, Jalagaon, Jodhpur, Kota, Miraj, Pune, Rajkot, Solapur, Surat, Veraval
South	12	Anantapur, Arogyawaram, Gulburga, Hanamakonda, Hyderabad, Kalingapatnam, Khammam, Kurnool, Madurai, Mahabubnagar, Mysore, Vizag
Central	9	Akola, Ambikapur, Bhopal, Hosangabad, Indore, Jabalpur, Jagdalpur, Nagpur, Seoni

Table 2 : Trends in temperatures in different regions of India

Region	No. of stations	Increasing trend (% of the stations)	Decreasing trend (% of the stations)	No trend (% of the stations)
a. Maximum temperature				
North	5	20	20	60
East	7	57	29	14
West	14	43	14	43
South	12	75	8	17
Central	9	67	-	33
b. Minimum temperature				
North	5	80	20	20
East	7	88	-	12
West	14	57	29	14
South	12	75	8	17
Central	9	88	-	12
c. Average temperature				
North	5	40	20	40
East	7	72	14	14
West	14	57	21	21
South	12	75	8	17
Central	9	88	-	12

annual mean minimum temperature showed a net increase in Jorhat region of Assam State during the last decade (1991-2000) when compared to previous two decades (1970-1990). Decreasing trend in minimum temperature was seen in 29 per cent of stations in west region followed by 20 per cent and 8 per cent stations in north and south region respectively (Table 2). No trend was noticed in 20 per cent of stations in north region followed by 17 in south region, 14 in west and 12 each in east and central region (Fig.1b). More number of stations in all regions are showing increasing trend in minimum temperature (more than 57%) than maximum temperature. This is cause of concern for agriculture, as increased night temperature will accelerate the respiration rate, and hasten the maturity, which in turn reduce crop yields. In total, all regions of India especially east and central regions showing increased trend in minimum temperature.

Average temperature trends

In case of average temperature trends, all regions followed the same pattern as in the case of minimum temperature except in north region where 40 per cent of stations have shown increasing trend (Fig.1c). Decreasing trend in average temperature was noticed in 21 per cent of stations in west region followed by 20 per cent in north region, 14 per cent in east region and 8 per cent in south region (Table 2). No trend in average temperature was seen in 40 per cent of stations in north region followed by west (21%), south (17%), east (14%) and central (12%). The studies of Divya and Mehrotra (1995) showed that, the steady increase in the mean annual temperature for India is in contrast to the post-1940 cooling observed for the northern hemisphere.

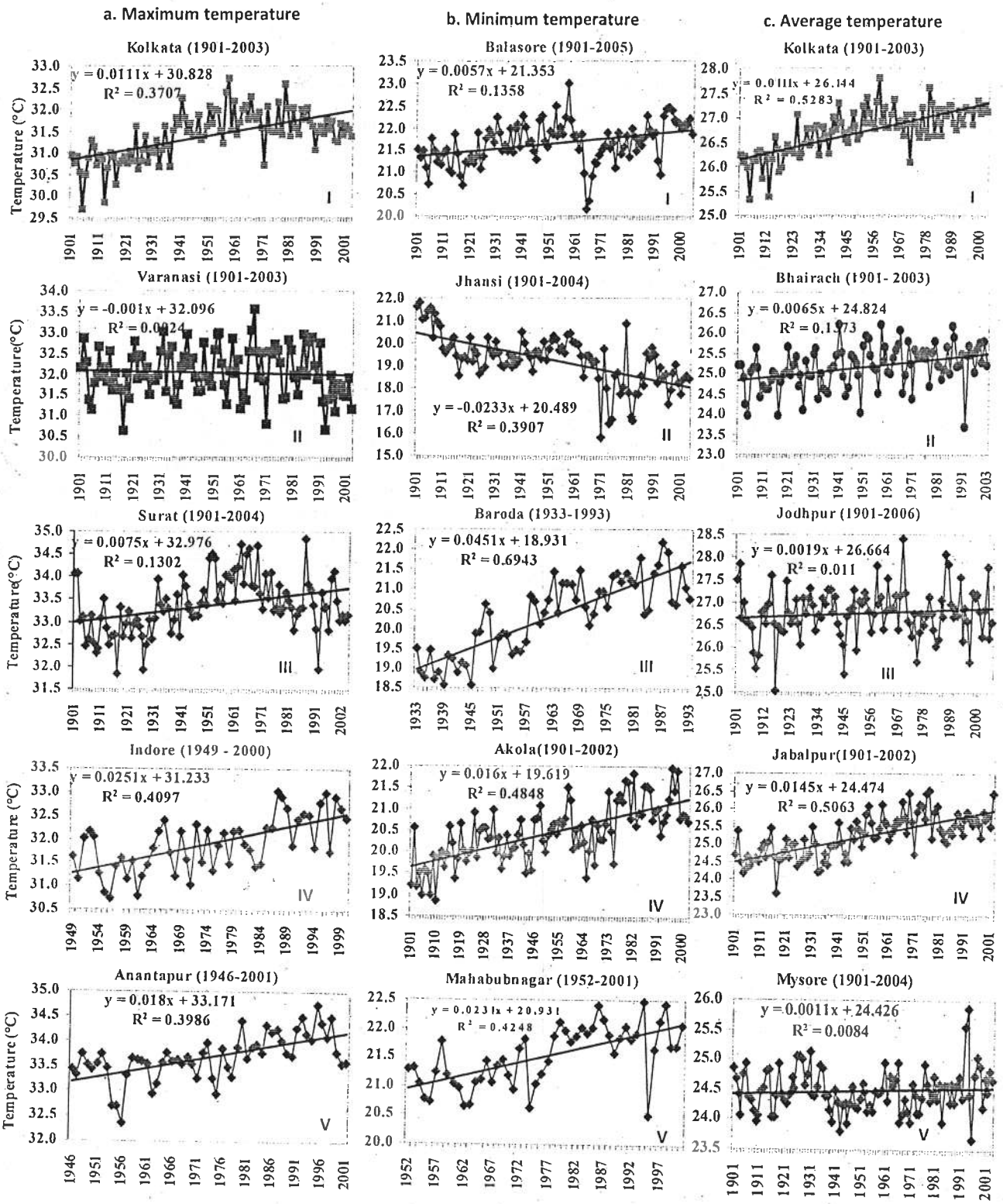

Fig.1: Trend in annual maximum, minimum and average temperature at selected locations of five regions (I-East; II-North; III-West; IV-Central; V-South) of India

CONCLUSION

The trend analysis of temperature over selected locations in India indicates that the increase trend in maximum temperature is seen, lowest in 20 per cent stations in north region and highest 75 percent of the stations in south region. On the other hand, increase in minimum temperature is observed in above 60 per cent of stations over all regions of India. Same trend is noticed in average temperature trend except in north region where 40 per cent of stations have shown increasing trend. Decreasing trend is also seen in mean, mean maximum and mean minimum temperature in all regions but in did not exceed 30 per cent. The peculiar result of this study is three by fourth of the stations in south region showed an increasing trend in maximum, minimum and average temperatures, which is not seen in stations of other regions.

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